Emerging Per- and Polyfluoroalkyl Substances (PFAS)

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Northeastern University
Social Science Environmental Health Research Institute

Highly Fluorinated Compounds
Social and Scientific Discovery
Northeastern University Social Science
Environmental Health Research Institute
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Overview

- Sources and exposure pathways of legacy PFAS (PFOS & PFOA) somewhat known

- USEPA's Stewardship Program has reduced legacy PFAS but has also resulted in the development of many new "emerging" PFAS

- New analytical capabilities (high resolution mass spectrometry) allow detection of many new PFAS

- Emerging PFAS almost completely uncharacterized with regard to sources, environmental fate, human exposure implications

- Discussion of some recent research on sources of emerging PFAS, human exposure pathways, overall implications

US Environmental Protection Agency
PFOA Stewardship Program

In January 2006, USEPA started this program to help minimize impact of PFOA in the environment

Eight major international companies have agreed to participate (including 3M, DuPont, Asahi Glass, Daikin)

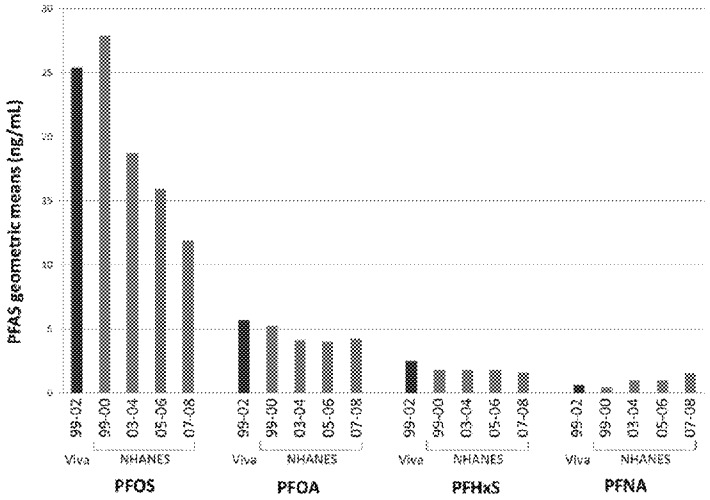
Agreement to voluntarily reduce factory emissions and product content of PFOA and related compounds* on a global basis by 95% no later than 2010

Agreement to work toward total elimination of emissions and product content of these compounds by 2015

Based on emissions and content determinations made for 2006

* Includes PFOA, precursor chemicals that can break down to PFOA, higher homologues (C9 and larger)

Trends in PFAS Serum Levels in US

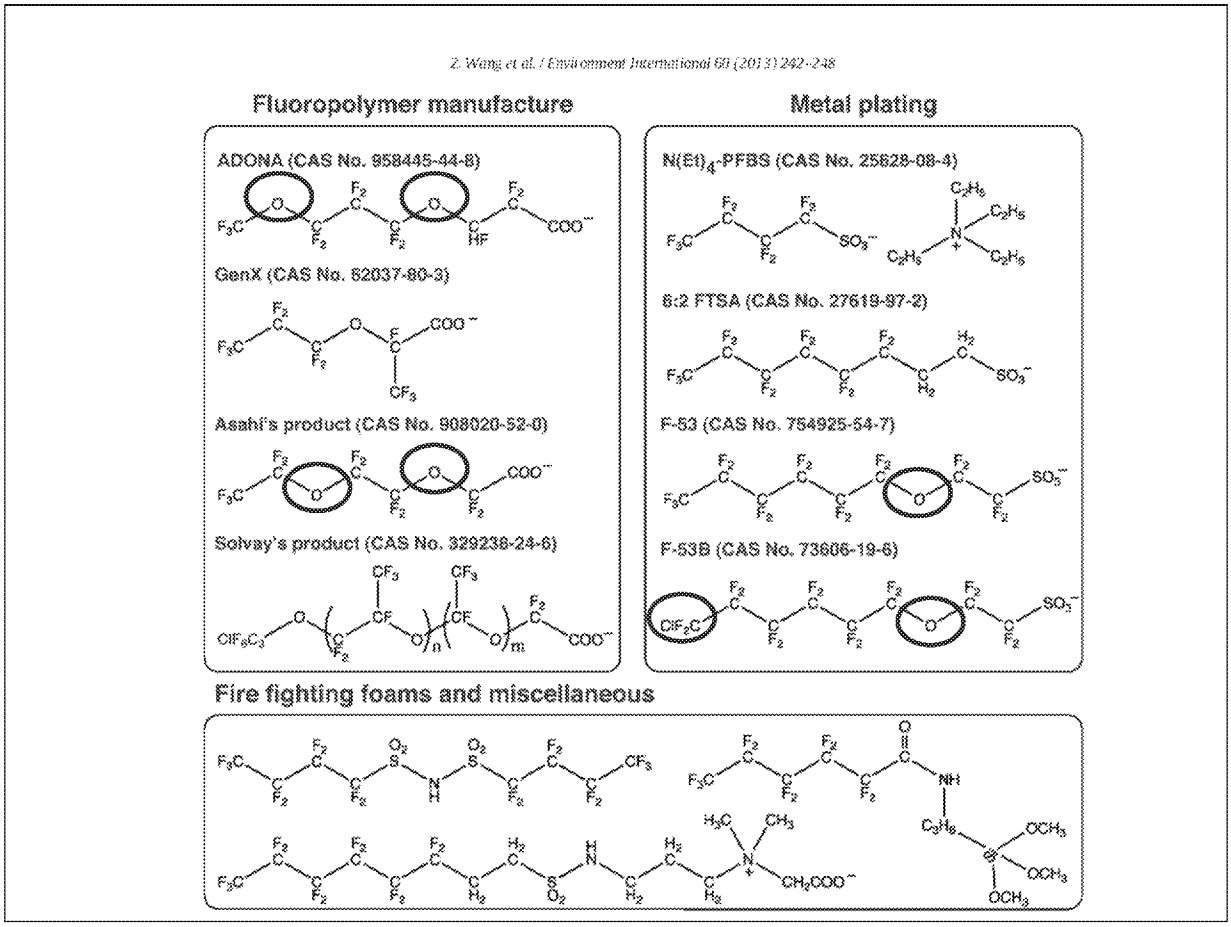


Sagiv et al. *Environmental Science & Technology* 2015, 49, 11849−11858

Table 2. Geometric mean and 95% confidence interval and selected percentiles of PFOS, PFOA, PFHxS, and PFNA serum concentrations (ng/mL) for the U.S. population 12 years of age and older: Data from NHANES 2011-2012 [a]

	Geometric Mean (95% Confidence Interval)		Selected Percentiles			
			50th	75th	90th	95th
PFHxS	1.28	1.15-1.43	1.27	2.26	3.81	5.43
PFOS	6.31	5.83-6.82	6.51	10.48	15.62	21.68
PFOA	2.08	1.95-2.22	2.08	3.02	4.35	5.67
PFNA	0.88	0.80-0.97	0.86	1.30	1.95	2.54

[a] CDC (2015)



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Work approached for detection not quantification

Unknown characteristics of “emerging” fluorinated compounds

- Actual identities of alternatives unknown in industrial sectors and geographical regions that are not well regulated

- Data on environmental and human health effects are incomplete (at best) and more often nonexistent

- Data on degradability, bioaccumulation, and toxicity (environmental and human) are incomplete (at best) or completely lacking

- Information on production volume and environmental emissions not available

Z. Wang et al. / Environment International 60 (2013) 242–248

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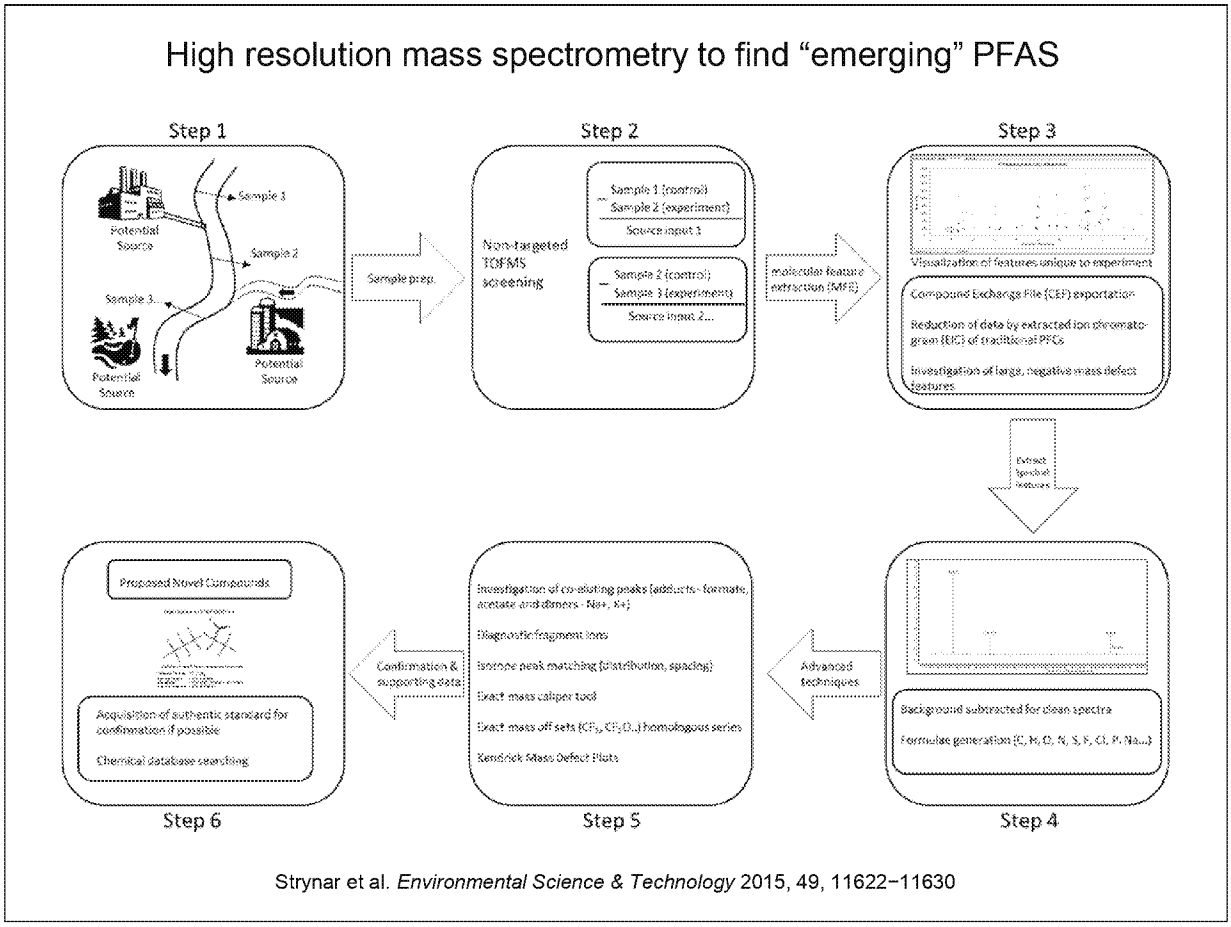
Work approached for detection not quantification



Strynar et al. *Environmental Science & Technology* 2015, 49, 11622−11630

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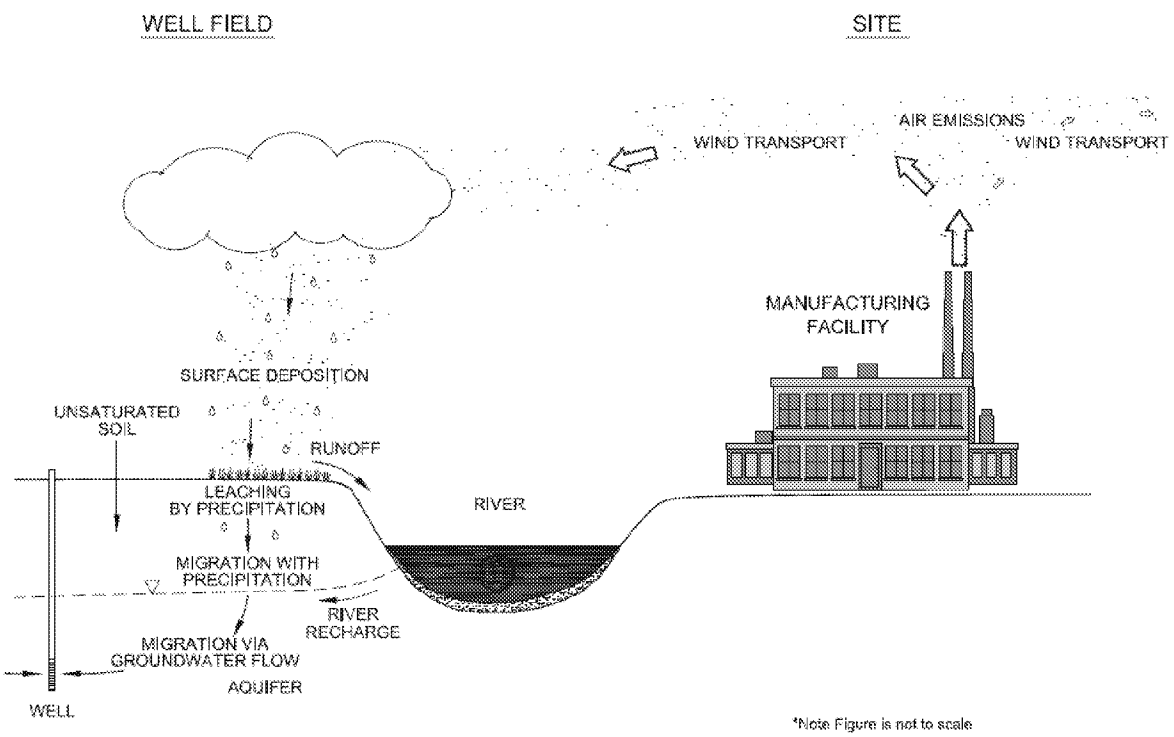
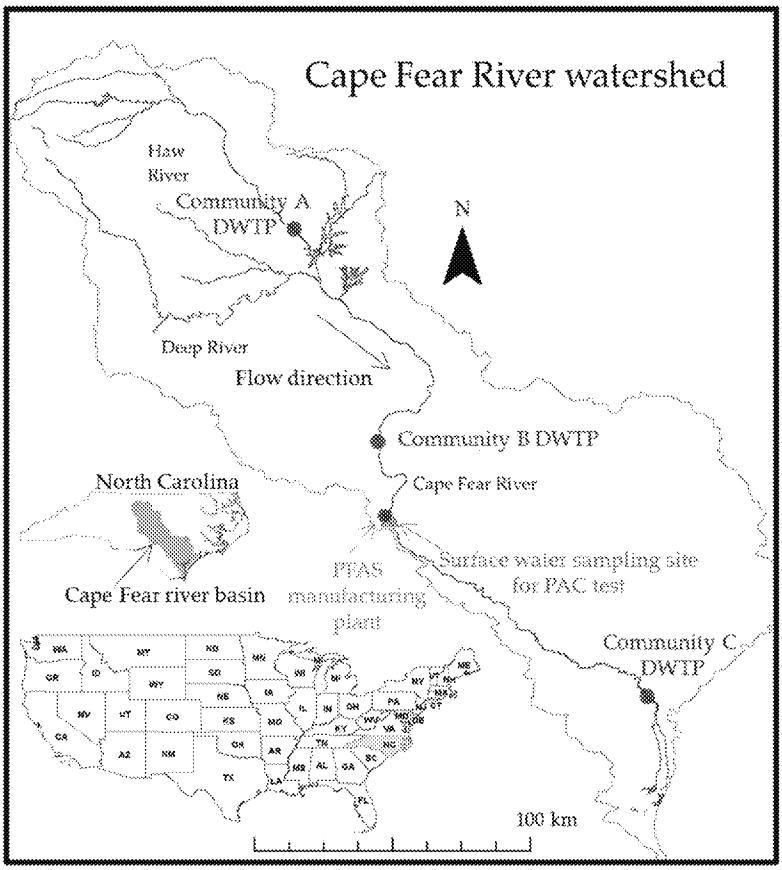
Work approached for detection not quantification



Davis et al. Chemosphere 67 (2007) 2011–2019



Sun et al. *Environmental Science & Technology Letters* 2016, 3, 415−419

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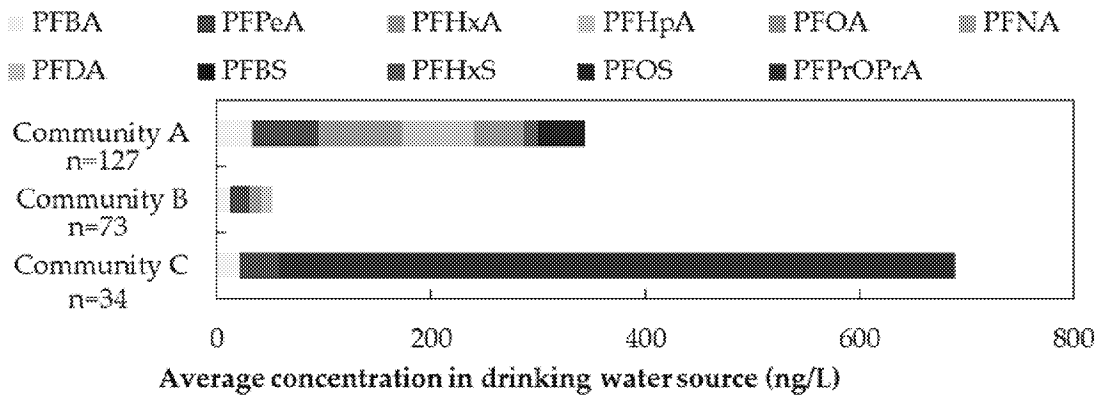
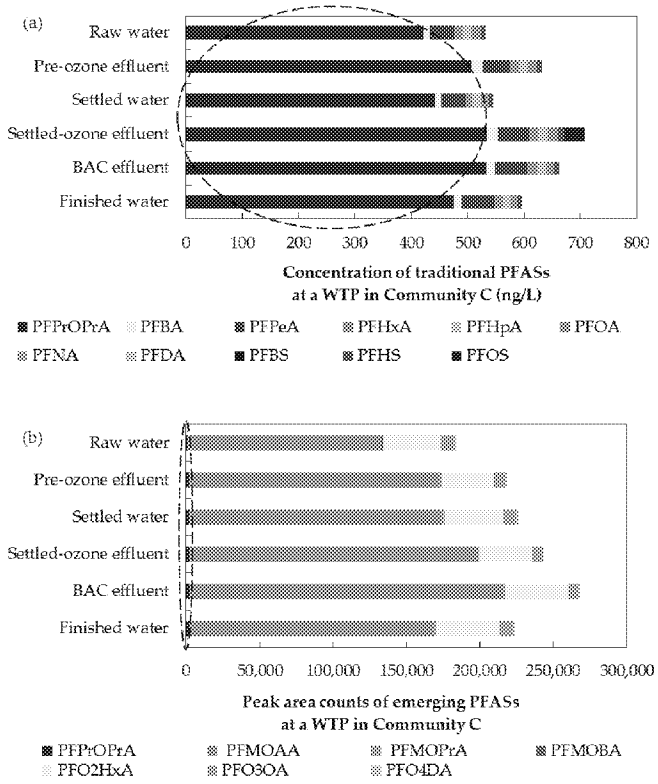
Work approached for detection not quantification

Legacy PFAS with GenX in Cape Fear River Basin



Sun et al. *Environmental Science & Technology Letters* 2016, 3, 415−419

Emerging PFAS in Cape Fear River Basin



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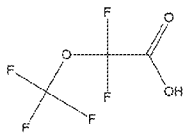
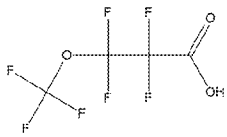
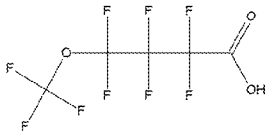


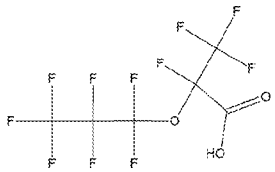
PFMOAA



PFMOPrA



PFMOBA



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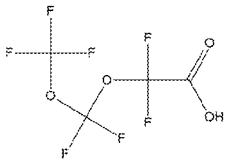
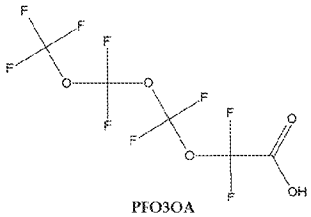
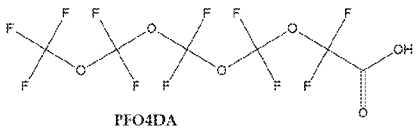


PFO2HxA



PFO3OA



PFO4DA

Sun et al. *Environmental Science & Technology Letters* 2016, 3, 415−419

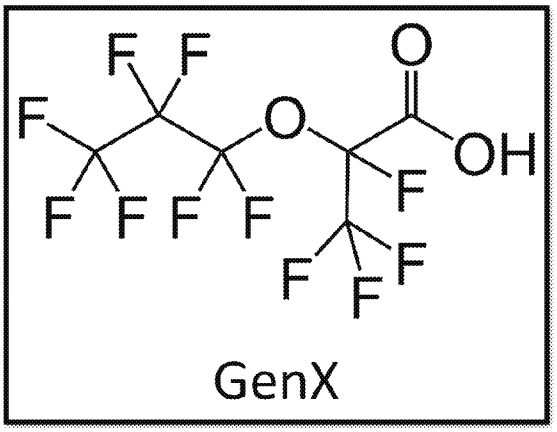
GenX

Identity originally protected as Confidential Business Information (CBI)

Still persistent, still toxic, but less bioaccumulative than C8

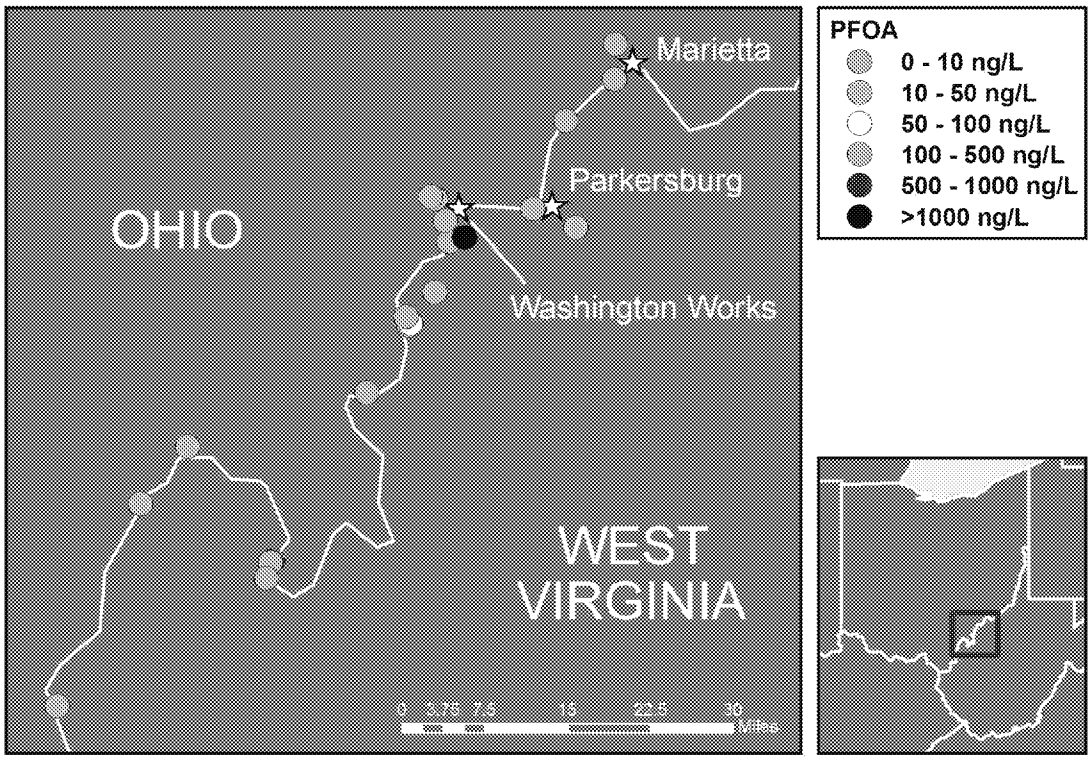
DuPont studies found effects on rats similar to C8, including possible endocrine/immune disruption, enlarged livers and kidneys, and cancer

Approved by the EPA, no further testing required

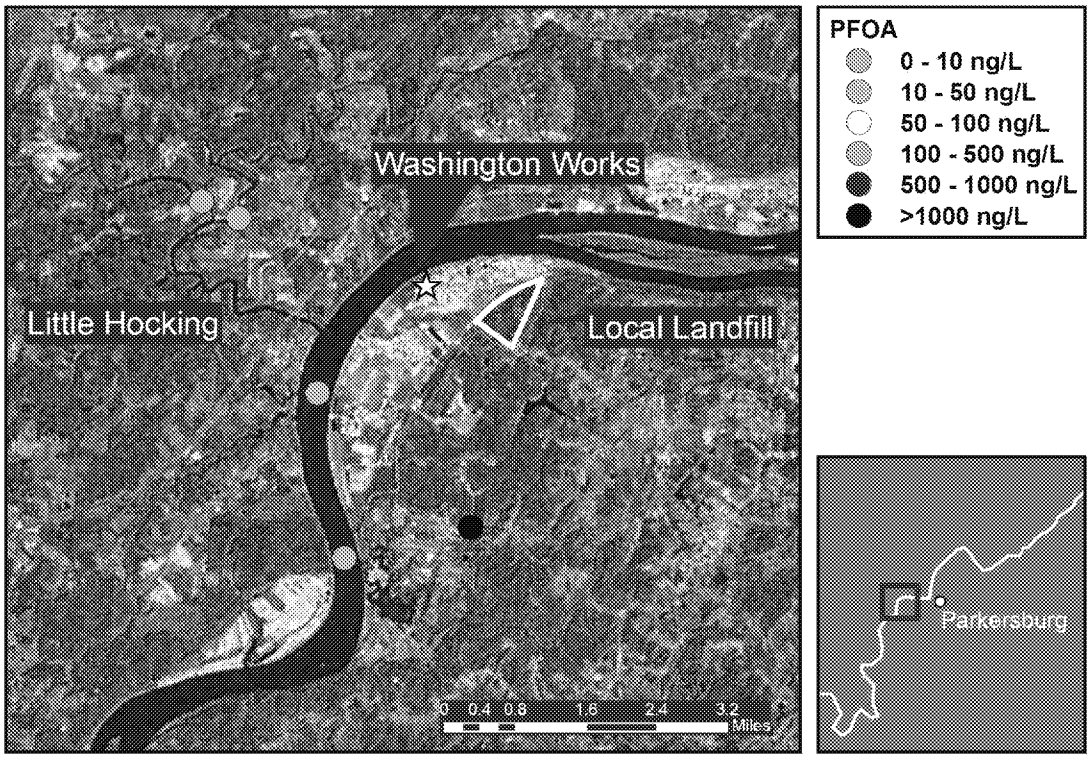


Trip #1 – Ohio River

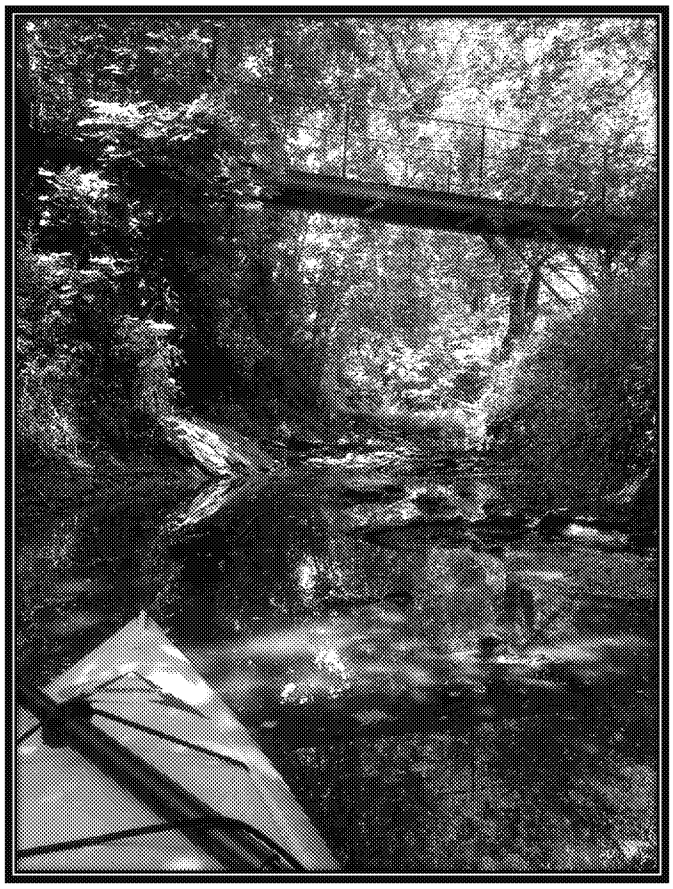
Ohio River Results



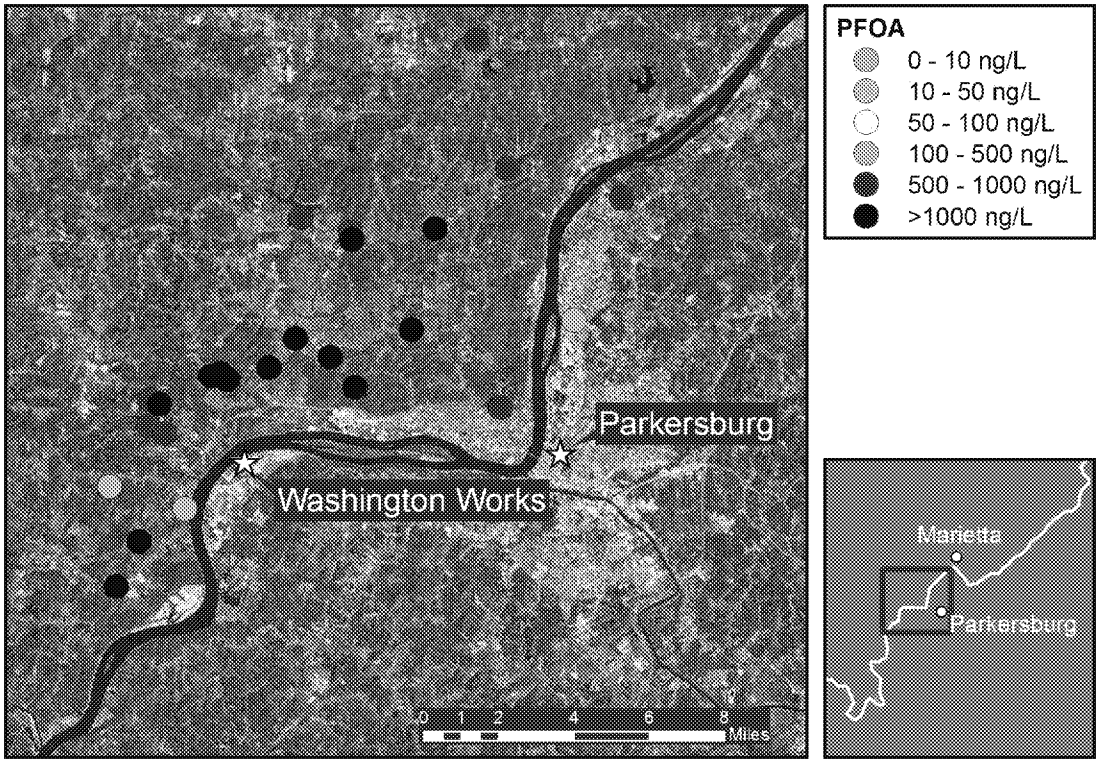
Ohio River Results (Detail)



Trip #2 – Little Hocking River

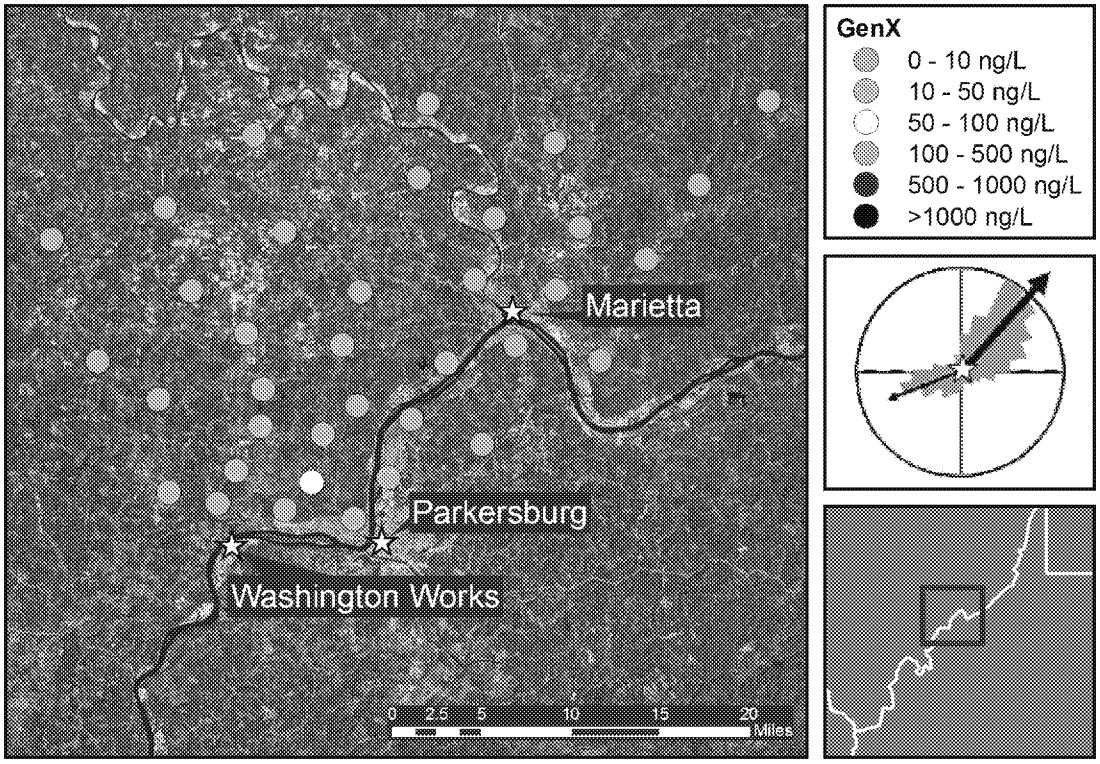


Little Hocking Results



Trip #3 – Little Hocking and Beyond

Extended Sampling Results

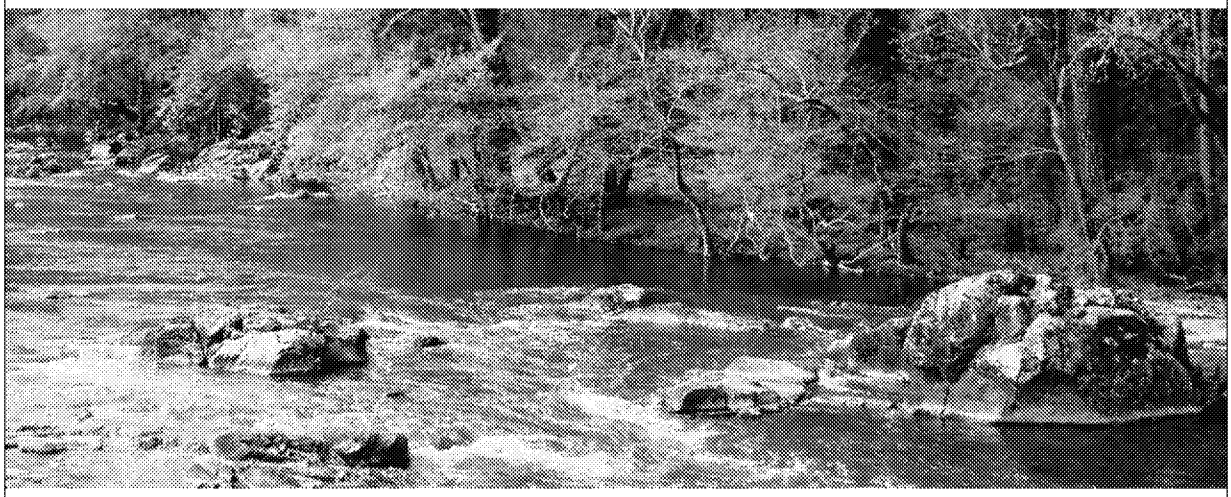


Conclusions

- The presence of significant levels of PFOA (>100 ng/L) in surface water more than 15 miles from the facility and quantifiable levels (>10 ng/L) more than 25 miles away suggest local contamination may be more extensive than originally thought.

- The discovery of GenX at many of the collection sites suggests the replacement PFAS is contaminating the local environment via air deposition as well.

- More testing is needed – especially private well water between the historic testing area and the Muskingum River.

Questions?

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